

AIR-BORNE INFECTIONS. Diseases due to air-borne infections enter the human body in three ways: through the respiratory tract, through the skin, and through the digestive tract. The diseases entering through the nasopharynx are in the maximum both in number and in importance. As scientific observations multiply, significant additions are being made to the list of infections entering through the air tract. This list now comprises the exanthemata, and nearly all diseases due to the local or distant effects of bacterial parasites. The only exceptions are the few diseases caused solely by the entrance of the pathogenic microorganisms directly into the tissue or through the walls of the alimentary canal and genito-urinary tract.

A partial list of affections which may be acquired by means of the inspired air, and many of which are exclusively thus acquired are: the exanthemata; tuberculosis; leprosy; glanders; actinomycoses; syphilis; influenza; infection by pyogenic bacteria affecting brain, cord, ears, nose, and throat, larynx or lungs, and heart; epidemic parotiditis; epidemic cerebrospinal meningitis; epidemic poliomyelitis; rheumatism; lobar pneumonia; bronchopneumonia; coryza; chorea; gastric and duodenal ulcer; arteriosclerosis; functional irregularities of the internal secretions; myxedema, Graves' disease; Addison's disease; acromegaly; pericarditis; myocarditis; endocarditis; asthma; hay fever; lymphadenitis; typhoid fever; purpura hemorrhagica; pertussis; diphtheria; nephritis; meningitis; sinusitis; mastoiditis; appendicitis; leukemia; Hodgkin's disease. All diseases except venereal disease, animal parasites, local intestinal diseases and local skin diseases may be included in the above list of diseases entering by way of the air tract.

CONCLUSION. The number of these primary air-tract infections is so great, and their importance is so overwhelming, that the point of entry of the infection—the nasopharynx—is invested with a spectacularly strategic importance from an etiological and clinical point of view.

METABOLISM STUDIES IN A CASE OF MYASTHENIA GRAVIS.¹

BY THEODORE DILLER, M.D.,

AND

JACOB ROSENBLUM, M.D., Ph.D.

PITTSBURGH.

(From the Wards of St. Francis Hospital and the Biochemical Laboratory of the Western Pennsylvania Hospital, Pittsburgh, Pa.)

I. INTRODUCTION. In the normal individual the extent of the consumption of energy is largely dependent upon the conditions of

¹ Read in abstract before the Pittsburgh Academy of Medicine, February 10, 1914.

the muscular system. On this account we would expect to find, when muscular activity and muscular tone are depressed by a pathological condition of the muscle as seen in myasthenia gravis, some changes in the metabolic functions of the body.

II. CLINICAL HISTORY OF CASE. (By Dr. Diller.) The patient is a boy, aged sixteen years, who was first examined for Dr. Diller by Dr. George J. Wright, March 3, 1913. His chief complaints were weakness in the legs, back, and in chewing. This weakness grew much worse with use of the muscles, and he frequently stumbled and fell.

The family history is good. The father and mother and two sisters and brothers are all living and well. The boy himself developed as a hearty, rugged youth, and went to school until two months ago. As a child he had measles, chicken-pox, and smallpox. He has had no acute illness in the past five years, except an attack of tonsillitis, which occurred one year ago.

The present illness began about three months ago, with drooping of the right eyelid. On several occasions he has seen double. About two months ago he noted that he would stumble over any unevenness on the street, and was conscious that his legs were weak. At the same time he noted that his jaw muscles were weak, and that they gave out, especially in chewing anything hard. Afterward he noted that his speech would become more and more indistinct as he talked. He has had no headaches nor pains of any sort. There has been no change in his mental condition.

Examination. The patient is a tall boy, large for his age, weighing 146 pounds. His color is good. There is considerable ptosis of the right lid. The face is smoothed out and expressionless. The pupils are equal, $3\frac{1}{2}$ mm., respond to light and accommodation; no nystagmus. When he makes an effort to look to the left, in the extreme movement, he sees double; but there is no apparent strabismus. The muscles of the face are all weak; the masseters are distinctly weak. He cannot pucker his lips nor make forcible movements, as in laughing. The movements of the arms and legs are all weak, as tested by resistance. The gait is distinctly weak. Dyn. right, 42; left, 34. Several times in dressing and undressing the boy tired out and was compelled to rest. The effort necessary to put on his collar was almost too much for him, and he had to call his mother to his assistance. He quickly tires upon any exertion. After reading aloud a few minutes his articulation becomes indistinct and finally unintelligible. The masseters likewise tire quickly. Indeed all muscles of the body tire readily. The tendon reflexes are all greatly reduced.

No tremors; no atrophies; no sensory changes of any sort. The boy's mind seems perfectly clear.

The boy remained in the hospital about four weeks. After

the conclusion of the experiments made by Dr. Rosenbloom, covering eight days, the boy was given regularly 10 grams calcium lactate; he continues to take this remedy up to the present time (May 15.) He left the hospital after a month's stay, appearing to have made some slight improvement.

April 30, the boy's mother writes: "He does not seem any worse; in fact, I think he seems to be improving slowly. He can swallow better. He is as happy as a lark, and planning what he is going to do when he gets well."



Case of myasthenia gravis. Note general appearance of muscular weakness, especially smoothed-out appearance of face and partial ptosis of right lid. (Kindness of Dr. A. Henrici.)

III. METABOLISM STUDY (By Dr. Rosenbloom). 1. *Review of Literature.* Pemberton² found a marked loss of calcium by the tissues, during a time of nitrogen retention, in a study of a case of myasthenia gravis. He also found that the creatinin excretion was lower than normal, and thinks that myasthenia gravis is a disease of deranged muscular metabolism.

Spriggs³ also found a lessened excretion of creatinin in a case of myasthenia gravis. The uric acid excretion in his case during a period of no fever was normal.

Kaufmann⁴ has studied the effect of muscular work in a case of myasthenia gravis. In the first series the patient had an intake

² AMER. JOUR. MED. SCI., 1910, cxxxix, 816.

³ Quart. Jour. Med., 1907, vii, 63.

⁴ Monats. f. Psych. u. Neurol., 1906, xx, 299.

of 0.24 gram nitrogen and 42.4 calories per kilo body weight. During a period in which the symptoms were slight the patient retained 3.57 grams nitrogen per day; in a period when the patient daily walked about 1000 meters, typical signs of disease appeared and the nitrogen retention amounted to 2.38 grams nitrogen. In the later period, when the condition had practically disappeared, the nitrogen retention amounted to about 4.3 grams per day. When the investigations were repeated and during the first period the patient was supplied with 0.29 grams nitrogen and 48.7 calories per kilo; 4.69 grams nitrogen were retained each day.

In the second period, during which general prostration and ptosis appeared after muscular work, there was a retention of 2.26 grams nitrogen; in the third, during perfectly good health, 5.52 grams. In a third series of observation the intake was only 0.14 grams nitrogen and 4.4 calories per kilo. During the first period there was a loss of 0.28 grams nitrogen, in the second 0.96 grams, and in the third a retention of 2.55 grams daily. The relation between the total nitrogen, urea, and ammonia was as follows: In the days when the patient was well the urea was from 82 to 86 per cent. of the total nitrogen; ammonia-nitrogen, 3.5 to 3.7 per cent. When signs of fatigue appeared the urea was diminished to 62.4 to 74 per cent. of total nitrogen and the ammonia increased to 8.6 to 13.2 per cent. of the total nitrogen.

The high ammonia indicates an increased excretion of acids. He found large quantities of lactic acid in the urine and blood serum on the days of work. In this case, as in the cases of Mohr⁵ and Boldt,⁶ the liver was diseased, and it seemed as if the appearance of the myasthenia coincided with the extent of the formation of the intermediary products of metabolism. Kaufmann also estimated the creatinin on two days, finding it very low, but his results cannot be considered accurate, as the zinc chloride method was used. Spriggs could not detect any increase of lactic acid in the blood in the case of myasthenia gravis studied.

From the work of Loeb and others we know that the calcium ion plays an important part in normal muscular action, and on account of this fact, and the finding of Pemberton of a marked loss of calcium in a case of myasthenia gravis, we paid special attention to the calcium metabolism of our patient.

Folin has suggested that the creatinin output on a meat-free diet in any individual is a constant, independent of muscular work, and is an expression of the endogenous cellular metabolism. Shaffer believes the urinary creatinin is the result of some special process of normal metabolism, which takes place to a large extent, if not entirely, in the muscles, and that the amount of creatinin

⁵ Berl. klin. Woch., 1903, No. 46.

⁶ Monats. f. Psych. u. Neurol., 1906, xx, 39.

in the urine, expressed in milligrams per kilo of body weight, is an index of this special process, and claims that the muscular efficiency of the individual depends upon the intensity of this process. He found that normal individuals excreted between 7 to 11 milligrams of creatinin-nitrogen per kilogram of body weight. Spriggs believes urinary creatinin is a product of the internal structural metabolism of muscle and not of its contraction. On account of the interest in the creatinin excretion of individuals suffering from muscular disease, we also included in our study the excretion of creatinin and creatin by our patient.

2. *Metabolism Methods.* During the entire experiment upon our patient he received daily the Folin⁷ diet, consisting of:

Whole milk	500 c.c.
Cream	300 c.c.
Eggs (whole)	450 gm.
Horlick's malted milk	200 gm.
Sugar	20 gm.
Salt	6 gm.
Distilled water (about)	2000 c.c.

From the fourth to eighth day of the metabolism experiment about 300 grams of egg-yolk was added to the above diet, hoping that if this patient was losing calcium the increased phosphorus intake might cause a retention of calcium. The mixture was prepared fresh every day, and portions taken out for analysis. The ammonia, total nitrogen, urea, creatin, and creatinin were estimated in the fresh urine, but the other constituents were estimated at the end of the experiment. The feces were marked off by means of carmine into periods of two days.

(a) *Methods Used in Urine Analysis.* The nitrogen was estimated by the Kjeldahl method. The ammonia by the Folin⁸ method. The total sulphur by the Benedict⁹ method. Total and ethereal sulphates by the Folin¹⁰ method. The inorganic sulphates computed by subtracting the ethereal sulphates from the total sulphates and the neutral sulphur by subtracting the total sulphate-sulphur from the total sulphur. Urea was estimated by the Benedict¹¹ method. Total phosphorus by the Neumann¹² method, weighing the phosphorus as magnesium pyrophosphate. Creatinin and creatin by the Folin¹³ method. Uric acid by the Krüger-Schmidt¹⁴ method. Calcium and magnesium by the McCrudden¹⁵ method.

⁷ Amer. Jour. Phys., 1905, xiii, 45.

⁸ Zeit. f. physiol. Chem., 1902, xxxvii, 161; Amer. Jour. Phys., 1903, viii, 330.

⁹ Jour. Biol. Chem., 1909, vi, 363.

¹⁰ Amer. Jour. Phys., 1905, xiii, 51; Jour. Biol. Chem., 1906, i, 131.

¹¹ Jour. Biol. Chem., 1911, viii, 405.

¹² Zeit. f. physiol. Chem., 1902, xxxvii, 129; 1904, xliii, 35.

¹³ Amer. Jour. Phys., 1905, xiii, 45.

¹⁴ Zeit. f. physiol. Chem., 1905, xlv, 1; Jour. Biol. Chem., 1908, vii, 27.

¹⁵ Jour. Biol. Chem., 1911, x, 187.

(b) *Methods Used in Analysis of Food.* Nitrogen by the Kjeldahl method. Total sulphur by the Wolff and Osterberg¹⁶ method, a modification of the Benedict method. Calcium and magnesium by the McCrudden method after ashing and extracting the ash with hydrochloric acid. Phosphorus by the Neumann method. Fat was estimated in two-day periods by extraction in Soxhlet apparatus.

(c) *Methods Used in Analysis of Feces.* Nitrogen by the Kjeldahl method. Sulphur by oxidizing with fuming nitric acid followed by the Benedict method. Phosphorus, calcium, and magnesium were estimated by the same methods as used for the food. Fat by the Kumagawa and Suto method.¹⁷

DISCUSSION OF TABLE I. It is of great advantage to use the Folin diet in metabolism experiments, as Folin in his fine investigations on the composition of normal urines has given us the means whereby we can compare the results obtained in diseased states, with his normal values, thereby facilitating the explanation of pathological findings. This diet is a purin-free diet, consisting of about 119 grams protein, 148 grams fat, and 225 grams carbohydrate.

It may be noted that in the last six days of the experiment the patient lost 3.6 grams nitrogen. The relation of the urea-nitrogen and ammonia-nitrogen to the total nitrogen is normal in character, showing no acidosis was present. The creatinin excretion is definitely less than normal, while the creatinin-coefficient is just about one-half the normal. This finding seems to point to the fact that myasthenia gravis may be a disease of deranged muscular metabolism.

The uric acid excretion both in amount and in relation to the total nitrogen is below normal. The amount of undetermined nitrogen excreted in the urine is normal. The protein absorption as deduced from the amount of nitrogen in the feces was also normal.

In this case of myasthenia gravis there is no doubt that the true cellular or "endogenous" metabolism is not proceeding along normal lines, as both the uric acid and creatinin excretion are much lower than normal, two constituents of urine, which form a good criterion as to the extent of the cellular metabolism. The finding seems to emphasize the necessity of considering myasthenia gravis as a disease of deranged muscular metabolism.

The accompanying tables contain the data obtained in this study:

¹⁶ Bioch. Zeit., 1910, xxix, 429.

¹⁷ Ibid., 1908, ix, 337.

TABLE I.—The Nitrogen Metabolism and Urinary Nitrogen Partition.

Date, 1913.	Urine. ¹⁸											Feces					
	Volume, c.c.	Urea-nitrogen.		Ammonia.			Creatinin ¹⁹			Uric acid.		Undetermined nitrogen.		Nitrogen.			
		Grams.	Total nitrogen, per cent.	Grams.	Nitrogen.	Grams.	per cent.	Grams.	Nitrogen.	Total nitrogen, per cent.	Grams.	Total nitrogen, per cent.	Grams.	Nitrogen, per cent.	Nitrogen intake, grams.	Nitrogen balance, grams.	
March 14	920	16.5	13.7	83.0	0.76	0.63	3.8	1.14	0.42	2.5	0.48	0.16	0.98	1.60	9.7	14.9	.....
March 15	1070	16.5	13.7	82.8	1.21	0.99	6.0	0.81	0.30	1.8	0.46	0.15	0.91	1.36	8.3	15.6	.....
March 16	2000	16.8	14.1	84.0	0.92	0.76	4.5	1.24	0.46	2.7	0.45	0.15	0.89	1.33	7.9	15.4	-3.50
March 17	1380	17.2	14.4	83.6	0.86	0.71	4.1	1.46	0.54	3.1	0.49	0.16	0.93	1.39	8.1	20.6	+1.30
March 18	1140	17.0	14.3	84.2	0.85	0.70	4.1	1.21	0.45	2.7	0.43	0.14	0.83	1.41	8.3	20.2	+0.40
March 19	2140	17.3	14.7	85.1	0.68	0.56	3.3	0.96	0.36	2.1	0.39	0.13	0.75	1.55	8.9	23.8	-0.30
March 20	1650	16.9	14.2	83.8	0.71	0.59	3.5	1.33	0.49	2.9	0.37	0.12	0.71	1.50	8.8	23.1	+3.10
March 21	1900	17.0	14.4	84.5	0.87	0.72	4.2	0.96	0.36	2.1	0.42	0.14	0.82	1.38	8.1	15.5	-4.60

¹⁸ No creatin was present in the urine at any time.¹⁹ Average creatinin coefficient, 6.3 milligrams per kilo of body weight.

Average creatinin excretion, 1.04 grams per day.

Average creatinin-nitrogen excretion, 0.42 gram, or 2.5 per cent. of the total nitrogen excretion.

TABLE II.—The Sulphur Metabolism and Urinary Sulphur Partitions.

Date, 1913.	Urine.									Feces.		
	Sulphur. grams.	Sulphate sulphur.		Ethereal- sulphate sulphur.		Inorganic sulphate sulphur.		Neutral sulphur.		Sulphur, grams.	Sulphur intake, grams.	Sulphur balance, grams.
		Grams.	Total sulphur, per cent.	Grams.	Total sulphur, per cent.	Grams.	Total sulphur, per cent.	Grams.	Total sulphur, per cent.			
March 14	1.27	1.15	90.5	0.15	11.8	1.00	78.7	0.12	9.4	....	1.6	....
March 15	1.30	1.16	89.2	0.20	15.4	0.96	73.8	0.14	10.8	....	1.6	....
March 16	1.52	1.40	92.1	0.19	12.5	1.21	79.6	0.12	7.8	0.38	2.2	+0.30
March 17	1.36	1.30	95.6	0.10	7.3	1.20	88.3	0.06	4.4	0.38	2.2	+0.46
March 18	2.12	1.98	93.4	0.35	16.5	1.63	76.9	0.14	6.6	0.42	2.0	+0.54
March 19	2.08	2.00	96.1	0.18	8.6	1.82	87.5	0.08	3.8	0.42	2.0	+0.50
March 20	1.87	1.72	91.9	0.12	6.4	1.20	85.5	0.15	8.0	0.45	2.1	+0.12
March 21	1.45	1.30	89.6	0.15	10.3	1.15	79.3	0.15	10.1	0.45	2.0	+0.10

TABLE III.—The Calcium, Magnesium, and Phosphorous Metabolism.

Date.	Urine.			Feces.			Intake.			Balance.		
	Phosphorous, grams.	Calcium oxide, grams.	Magnesium oxide, grams.	Phosphorous, grams.	Calcium oxide, grams.	Magnesium oxide, grams.	Phosphorous, grams.	Calcium oxide, grams.	Magnesium oxide, grams.	Phosphorous, grams.	Calcium oxide, grams.	Magnesium oxide, grams.
March 14	....	0.45	0.14	....	2.2	0.10	2.6	1.8	0.32	....	-0.85	+0.08
March 15	....	0.48	0.15	....	2.4	0.10	2.6	1.8	0.32	....	-1.08	+0.07
March 16	1.31	0.60	0.15	1.4	2.1	0.12	2.4	1.9	0.37	-0.31	-0.80	+0.10
March 17	1.62	0.91	0.16	1.4	2.3	0.12	4.8	1.9	0.37	+1.06	-1.31	+0.09
March 18	1.90	0.56	0.20	1.6	2.0	0.15	5.2	2.6	0.44	+1.70	+0.04	+0.09
March 19	1.94	0.59	0.21	1.6	2.4	0.15	5.4	2.6	0.44	+1.86	-0.39	+0.08
March 20	1.98	0.95	0.20	1.9	2.6	0.14	5.5	2.8	0.43	+1.62	-0.75	+0.09
March 21	1.92	1.16	0.19	1.9	2.8	0.14	4.5	2.8	0.43	+0.68	-1.16	+0.10
Totals	10.67	5.70	1.40	9.8	18.8	1.02	28.6	18.2	3.12	+6.61	-6.3	+0.70
Averages	1.78	0.71	0.175	1.6	2.35	0.13	3.6	2.3	0.39	+1.10	-0.8	+0.087

DISCUSSION OF TABLE II. During the last six days of the experiment the patient shows a slight loss of sulphur. The amount of sulphur excreted as ethereal sulphate and as inorganic-sulphate is normal in character. The amount of neutral sulphur excreted in relation to the total sulphur is below normal. This finding also substantiates our idea that myasthenia gravis is a disease of deranged muscular metabolism, as Folin also claims that the neutral sulphur of the urine represents a partial expression of the endogenous or cellular metabolism, in the same manner as does the creatinin and uric acid excretion. As is well known, these three constituents of the urine are the truest index to the so-called "endogenous" metabolism of an individual. In this disease, we have therefore a low "endogenous" metabolism, and if it is true that the "endogenous" metabolism initiates and directs

the processes of cell life, we have a further proof for our idea that myasthenia gravis is a disease due to some metabolic perversion. It might be possible that the lack of utilization of the calcium ion prevents the "endogenous" metabolism proceeding in a normal manner.

TABLE IV.—Calcium Oxide and Magnesium Oxide Output.

Day.	Calcium oxide in urine, per cent.	Calcium oxide in feces, per cent.	Magnesium oxide in urine, per cent.	Magnesium oxide in feces, per cent.
1	16.9	83.1	58.3	41.7
2	16.6	83.4	60.0	40.0
3	22.2	77.8	55.5	44.5
4	28.3	71.7	57.1	42.9
5	21.9	78.1	57.1	42.9
6	19.7	80.3	58.3	41.7
7	26.7	73.3	58.8	41.2
8	29.2	70.8	57.6	42.4

DISCUSSION OF TABLES III AND IV. In this case of myasthenia gravis we have found a marked loss of calcium by the tissues, 6.3 grams calcium oxide in eight days, thereby confirming the findings of Pemberton. However, during a time of phosphorus retention produced by the feeding of egg-yolk, no effect was noted on the calcium metabolism.²⁰

A slight retention of magnesium was found, + 0.7 gram, during the eight days. On account of the great importance that the calcium ion plays in normal muscular action, it is tempting to think that possibly it is owing to some lack of utilization of this substance that the condition of myasthenia gravis owes its origin and that the changes we have observed in the "endogenous" or cellular metabolism in this disease may be secondary to this fact and as it has long been known that the inorganic ions are necessary for normal muscular action, as a hypothesis we might say that it is owing to some disturbance in metabolism of these substances, especially calcium, that the muscular symptoms of myasthenia gravis are due. We also know that during the work of muscle, lactic acid is produced, one of the factors in the production of fatigue of muscle. May it not be that owing to the fact that the calcium not being utilized normally, the lactic acid is not neutralized by the calcium and fatigue comes on readily, one of the characteristic features of myasthenia gravis? It must also be remembered that any perversion of calcium metabolism may give rise to symptoms in two ways, first, symptoms due to the loss of the calcium, and second, symptoms due to the excess of the other bases. A direct way to attack this problem would be to

²⁰ Loeb (Int. Beitr. z. Path. u. Ther. d. Ernähr., 1911, iii, 237) has also found that a phosphorus retention produced by feeding lecithin, was not accompanied by a calcium or magnesium retention.

devise some method to cause these patients to retain calcium and see if this retention had any favorable effect on the disease.²¹ The distribution of oxide and magnesium oxide in the feces and urine (Table IV) may be considered normal.²² The fat metabolism in this patient (Table V) is also normal in character. In connection with the possible influence that internal secretory organs may have on calcium metabolism, it should be remembered that many have found in myasthenia gravis some disease of the thymus.²³ It is possible that other secretory organs may exert some influence on calcium metabolism. McCrudden²⁴ found that improvements in the symptoms of osteomalacia, following castration, was accomplished by calcium retention, where there had been a loss before. Also, it has been found, that injections of epinephrin²⁵ have been of value in osteomalacia and in rickets. Carnot and Slavu²⁶ have shown that after injection of dogs subcutaneously with epinephrin, that ossification is much greater than in the controls. Quest²⁷ and also Stoltzner²⁸ have studied the effects of epinephrin administration in rickets in relation to the calcium metabolism. Parhan²⁹ has studied the influence of thyroid principle on calcium metabolism in rabbits, showing that ingestion of thyroid determined a loss of calcium from the tissues, which ran parallel to the amount of thyroid ingested.

TABLE V.—The Fat Metabolism.

Date, 1913.	Fat content of feces, grams.	Fat intake, per cent.	Fat intake, grams.	Fat balance, grams.	Fat absorbed, per cent.
March 14					
March 15	13.5	10.0	135	+121.5	90.0
March 16	14.5	10.0	145	+130.5	90.0
March 17	19.4	10.2	198	+178.6	89.8
March 18	21.1	10.2	215	+193.9	89.8
March 19	20.3	10.1	205	+184.7	89.9
March 20	20.6	10.1	208	+187.4	89.9
March 21	22.8	9.2	210	+187.2	90.8

Basch³⁰ has found that thymectomized dogs in comparison with controls of the same litter, revealed lessened growth, less consistency of the bones, and a changed psychical nature, two to three

²¹ I hope soon to study this problem, especially the effect of various internal secretory products on the metabolism of calcium in health and disease.

²² For list of ratio of the urinary and fecal calcium output in normal and pathological conditions, see Towles, *AMER. JOUR. MED. SCI.*, 1910, cxi, 100. For magnesium oxide, see Renvall, *Skand. Arch. f. Physiol.*, 1904, xvi, 94.

²³ Mandelbaum and Celler, *Jour. Exper. Med.*, 1908, x, 808.

²⁴ *Amer. Jour. Physiol.*, 1905, xiv, 211; 1906, xvii, 211.

²⁵ Bossi, *Centralbl. f. Gynäk.*, 1907, Nos. 3 and 6; 1907, xxxi, 1560; Stocker, *Corr.-Bl. f. Schweiz. Aerzte*, 1909, xxxix, 433.

²⁶ *Compt.-Rend. Soc. Biol.*, 1910, lxxviii, 832.

²⁷ *Zeitschr. expt. Path.*, 1908, v, 43.

²⁸ *Jahr. f. Kinderheilk.*, li, Nos. 1 and 2.

²⁹ *Compt.-Rend.*, 1913, lxxii, 620.

³⁰ *Jahr. Kinderheilk.*, 1906, lxiv, 285; *Wein. klin. Woch.*, 1903, xxxi, 893; *Deut. med. Woch.*, 1913, xxxix, 1456.

weeks following the thymectomy. They also showed an increased irritability of the cerebral cortex and peripheral nerves and that injections of soluble calcium salts brought the irritability back to normal. MacCallum and Voegtlin³¹ and also Erdheim³² have claimed a relation exists between the parathyroid glands and calcium metabolism.³³

THE SERUM DIAGNOSIS OF PREGNANCY AND ITS UNDERLYING PRINCIPLES.

BY JAMES S. McLESTER, M.D.,

PROFESSOR OF MEDICINE, THE GRADUATE SCHOOL OF MEDICINE OF THE UNIVERSITY OF ALABAMA, BIRMINGHAM.

IN his test for pregnancy, Abderhalden has opened a field which promises perhaps more for scientific investigation and for ultimate practical usefulness than any other present-day line of study. He and his pupils have devoted a great deal of brilliant investigation to the work of animal ferments, and this test for pregnancy, introducing new laboratory methods of almost unlimited possibilities, is the result of these studies. I shall not discuss the great mass of experiments dealing with this subject the results of which have been reported by various investigators within the past two years. It is too early for a critical survey. The exacting details of the method and the principles underlying it must be more thoroughly understood by those who attempt to follow Abderhalden's work before any effort can be made to reconcile results. I shall confine myself to a discussion of these principles and to a brief consideration of the technique.¹

All metabolic processes are in last analysis an expression of ferment activity. Each body cell is armed with ferments designed not only to protect it from foreign invasion, but which enable it to meet its requirements for energy, maintain its structural integrity, and perform its specific functions. The study of these cell ferments, overshadowing in importance everything else in physiology (and perhaps in pathology), is after all still in its infancy, for we know nothing of the exact nature of the chemical composition of ferments, and are forced to recognize them solely by the character of their work.

³¹ Jour. Exper. Med., 1909, ix, 118.

³² Frankfurt Zeitsch. f. Path., 1911, vii, 178.

³³ For review of literature regarding the influence of internal secretory organs on mineral metabolism see Bayliss and Staring, *Erg. d. Physiol.*, v, p. 664; Vincent, *Erg. d. Physiol.*, ix, p. 145; *Internal Secretion and Ductless Glands*, 1912 (Arnold); Oppenheimer, *Hand. d. Biochemie*, 1910, 3, part 1; Biedl, *Innere Sekretion*, 1913.

¹ References to the voluminous literature upon animal ferments have been omitted. This may be found in complete form in Abderhalden's *Abwehrfermente des tierischen Organismus*. Julius Springer, Berlin.